Predictive modelling of economic safety on the example of ecosystem of small and medium-sized business

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Abstract: The article examines the problems of monitoring the activities of small and medium-sized businesses in the framework of ensuring the economic security of the Russian Federation. The lack of economic information on the activities of small and medium-sized businesses hinders a competent assessment of the effectiveness of state support programs for business and the development of entrepreneurial ecosystems. The authors propose to use methods of predictive modelling to improve the economic security of the state and create effective innovative business ecosystems.

Keywords: economic security; predictive modelling; small and medium business; entrepreneurial ecosystem; economic safety; security management; security monitoring; economic threat; big data.

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1 Introduction

The aim of the study is to find effective tools for monitoring the economic security of the state and forecasting economic threats. The creation of a predictive model of the economic system is considered as such a tool. An example is the ecosystem of small and medium-sized businesses. The economic security of the Russian Federation has a number of criteria with threshold values. If the criteria do not match the threshold values, we can state that there is an economic threat. The actions of the mechanism for ensuring economic security should be aimed, first of all, at preventing economic threats.

2 Monitoring economic threats

Economic security, as an object of study of economic science, according to Abalkin (1994), is 'a set of conditions that protect the economy, state independence from external and internal threats, and is characterised by the following components: economic stability, the stability of the national economy, the ability to self-development and progress'.

> "The economic threat is a combination of conditions, factors and events, the implementation of which is capable of damaging the economically important interests of the individual, society and the state." (Krotov and Muntiyan, 2016)

Government activities to ensure economic security include regulatory measures (regulatory and legal aspects), measures of a direct nature (counteraction to economic threats) and information and analytical measures. Information and analytical measures include monitoring, modelling and forecasting of economic threats.

According to Senchagov and Ivanov (2015) the state's actions to protect economic security should be organically entered into the processes of forming state economic policy and the development of all specific documents that determine the development of the Russian economy. Measures to protect the economic security of the Russian Federation should not be merely the consequences of Western sanctions, but must be of a permanent nature. Thus, the creation of an effective mechanism for ensuring economic security, including modern methods of monitoring and forecasting economic threats, is an urgent topic.

Monitoring of economic security is carried out according to the Federal State Statistics Service (Rosstat) (statistical handbooks: *Russia in Figures* and *Socio-Economic Situation of Russia*). In monitoring economic security, of the previously developed 150 indicators, today the most important ones are used. It should be noted that in 2008 this list of key indicators was expanded to 36 due to the financial crisis, it included a number of financial and economic indicators. In 2011, the updated list of indicators was published. Decree of the President of the Russian Federation of May 13, 2017 No. 208 'On the Strategy for Economic Security of the Russian Federation for the period until

2030' established indicators of economic security in the amount of 40, but the list of indicators must be specified based on the results of monitoring economic security.

An important stage in monitoring economic security is the establishment of threshold values of observed indicators, which could be a guide for economic development. The Institute of Economics of the Russian Academy of Sciences regularly develops and refines the threshold values with a periodicity of four to five years. But they have never been approved or approved by any state agency and have not been used in the current activities of the state (Senchagov and Ivanov, 2015).

In monitoring the economic security of the state, as a rule, general macroeconomic indicators are used (for example, the percentage of GDP growth). The state of economic security of the state as a whole is influenced by the activities of industries, economic institutions and economic entities, for monitoring which the relevant indicators are used. For example, E.S. Kutukova classifies the indicators of economic security by the level of the object of economic security:

- the macroeconomic level, which is represented by the national economy
- meso level – the economy of regions and industries
- microeconomic level – economics of economic
- subjects
- family and individual level.

3 Modelling economic threats

The construction of models of economic systems is often not possible, because of their complexity, many parameters and laborious calculations. Therefore, separate and describe individual economic processes for certain tasks. For example, Dorovsky (2013) offers a technique for studying the economic security of the region using a simulation model based on a system of production functions by type of activity that allows us to assess the tasks of state regulation and forecasting. Modeling of economic security of industrial enterprise is studied by Andrashitov and Gesha (2016). It is modelled with the help of a set of tasks and critical levels.

Levkin et al. (2015) investigations are devoted to national security threats modelling.The authors propose an information-indicative threat model as a set of information, information and identification signs of ongoing activities with the conditions of the object of observation. The economic threat to the moment of its detection passes several stages: origin, development, realisation. The purpose of the mechanism for ensuring economic security is to prevent the development of a threat at the stage of origin (a potential threat), then the consequences for the managed facility will be the least deplorable. Monitoring the state of the object by the threshold values of the criteria makes it possible to identify the threat at the stage of its implementation, i.e., at the time of the damage. Thus, according to the authors, the most important stage of information and analytical measures is the forecasting of economic threats. Forecasting allows identifying the threat at the stage of origin and preventing it.

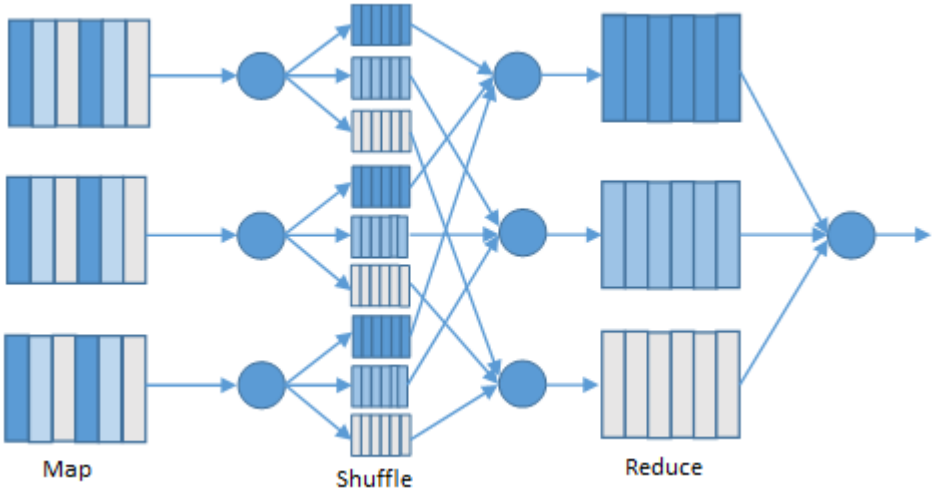
In recent years, the transition to a digital economy is an actual trend in the transformation of economic activity in many countries. One of the main digital

technologies of the Program 'Digital Economy of the Russian Federation', which is aimed at developing the economy in Russia is 'big data'.

The market for big data is one of the fastest growing in the world. The most active users of big data and predictive modeling are banks, retail, mobile networks and the public sector. The use of these tools provides companies with the following preferences: optimisation of business processes, analysis of purchasing behaviour, sales forecast, improving the quality of decision making when issuing loans, reducing paperwork, etc.

The company developed a technology for processing large amounts of data – MapReduce (Figure 1). This technology, working with computer clusters, includes filtering, shuffling, data output. MapReduce works with large databases, such as information on transactions of all bank customers, information about all purchases in a large retail network, etc. MapReduce has significant performance advantages in data processing compared to traditional solutions.

Figure 1 Data processing technology MapReduce (see online version for colours)



Source: https://blog.sqlauthority.com/2013/10/09/big-data-buzz-words-what-is-mapreduce-day-7-of-21/

Predictive modelling is the scientific basis of modern industrial technologies for processing data, signals, images, pattern recognition, as well as tasks to identify dependencies, relationships and their evolution. The technology of predictive modeling includes the collection and processing of data, the creation and configuration of a computer model, the formulation of scenarios, the calculation of the behaviour of the object in the framework of given scenarios, according to Ivanov and Bukhanovsky (2013).

Predictive modelling is widely used in high-tech industries and fundamental science, serves as an evidence base for making effective scientific and technical decisions about the structure and parameters of the projected facility and for predicting its behaviour under different control tasks and environmental conditions. Predictive modelling allows to solve the following tasks:

- revealing the dependencies between the state of the object and the factors influencing it
- prediction of the state of the object with the detection of the trend
- filling gaps and gaps in experimental data due to simulation results
- determination of quantitative and qualitative characteristics of the object in conditions that do not allow the possibility of experiment (extreme situations)
- planning of external influences with the purpose of development of effective methods of object management
- data collection and clustering.

However, according to Bukhanovsky (2018), the predictive model may have drawbacks related to the structure of the model itself, since no model can fully copy the object or system under investigation.

4 Monitoring of activity of small and medium business in the Russian federation

One of the tasks of implementing the strategy of Russia's economic security, related to sustainable growth of the real sector of the economy, is to support high-tech small and medium-sized businesses. For Russia, the creation of entrepreneurial ecosystems and ensuring their effectiveness is a priority in the framework of strategic development. Many indicators of the economic security strategy are related to the activities of small businesses such as the index of entrepreneurial confidence. This qualitative indicator is calculated by the Federal State Statistics Service (Rosstat) according to the responses of the managers of enterprises about the forecast of output, stocks, demand, i.e., the estimated data are used. Rosstat conducts annual, selective observations on small business. Rosstat's data are not comprehensive; are collected irregularly. For example, Rosstat collects a large number of quantitative and qualitative indicators for the circle of enterprises that present financial statements in the mode of continuous federal statistical (once in five years) and selective observations (Federal state statistics service. Methodological explanation). When performing selective monitoring of the activities of small enterprises, the following mathematical methods are used:

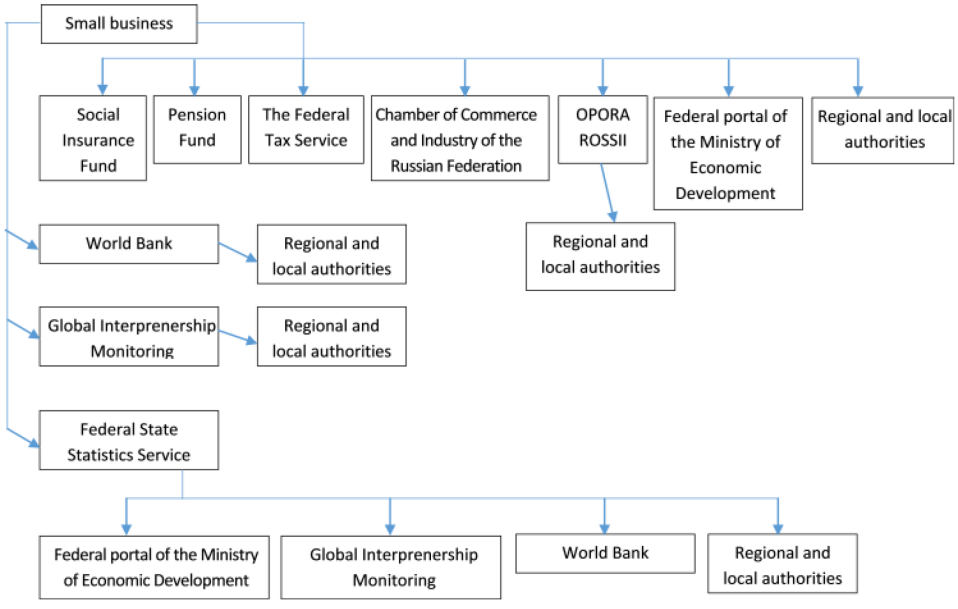
- 20% stratified random sample with the subsequent dissemination of the received data to the general set of small enterprises
- method of data imputation using a donor enterprise randomly selected in substitution groups
- non-responses are offset by adjusting the weights of the responding respondents.

Thus, the lack of data is compensated by mathematical calculations.

Small business, as the developed structural link of the Russian economy, in the process of interaction with controlling bodies and independent researchers, transfers to their databases information on the most important indicators of economic activity. The financial and statistical reports generated by enterprises are received by the relevant state

services, today – mainly via electronic communication channels (Figure 2). Independent organisations and business support funds conduct surveys and create analytical reports on them. This information in each case represents sets of various indicators in which this or that organisation is interested. For example, the Federal Tax Service has the most complete information on the financial condition of small and medium businesses. If it is possible to collect all the data on SMEs in one database, state structures, the scientific community and entrepreneurship, would receive a clearer and more relevant picture of their activities, the ability to forecast the direction of SME development.

Figure 2 Monitoring the activities of SMEs (see online version for colours)



Source: Compiled by the authors

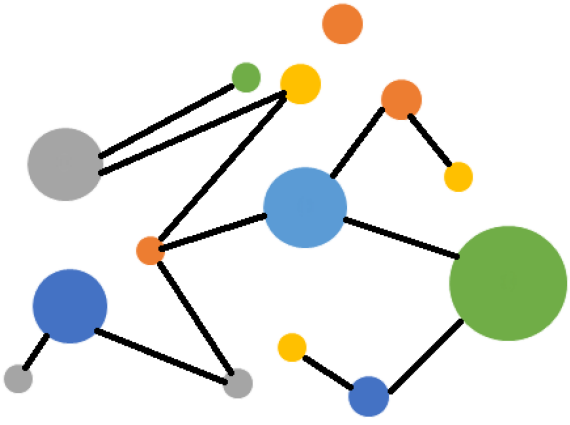
In view of the fragmented observations, a number of problems and limitations arise in assessing the effectiveness of state support. The activities of the authorities are connected with a significant restriction of researchers' access to information (for example, the tax secret regime of the Federal Tax Service, the law on personal data, etc.). In the reports of the Federal Tax Service and Rosstat it is not always possible to single out indicators that characterise the activities of small business entities. The problem of legalisation of the 'shadow economy' of small business still remains urgent; thus, the need to improve approaches to assess the effectiveness of state support for small businesses.

The state support of small business includes a serious potential to contribute to the development of this sector and enhance Russia's economic security, but it is not the only recipe. Prospects for small business development depend also on the overall business climate in the country, the magnitude of administrative, economic and organisational barriers. The change in these factors is a consequence of the ongoing state economic (in particular, industrial and competitive) policies, as well as the effectiveness of a set of measures and activities aimed at reducing excessive government intervention in the economy.

5 Development of the mechanism for ensuring economic safety of ecosystem of small and medium-sized business with the use of predictive modelling

The ecosystem of small and medium-sized businesses is a company that evolves together, concentrating its capabilities around certain innovations (Moore, 2006) (Figure 3). The main characteristics (domains) of the entrepreneurial ecosystem according to Isenberg (2011): culture, human resources, politics, markets, finance, support system.

Figure 3 Formation of links in the innovation ecosystem (see online version for colours)



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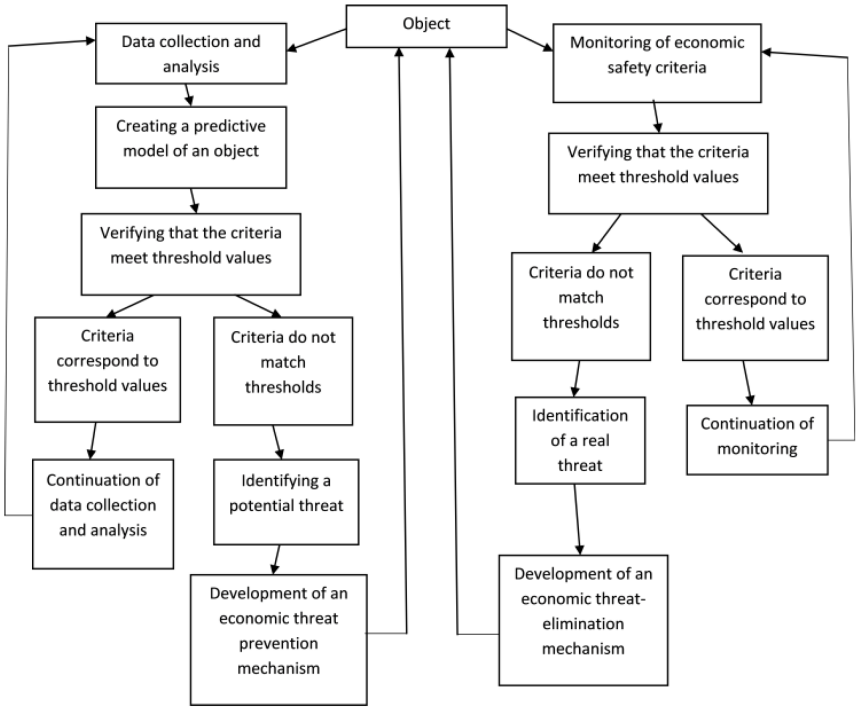
For an objective assessment of the achievement of the goals of state programs for the development of small and medium-sized businesses, the authors consider it necessary to select the tasks (areas of evaluation):

- quality of development of small enterprises
- resource efficiency
- the nature of the business climate
- social efficiency of small business
- effectiveness of innovation policy.

The mechanism proposed by the authors (Figure 4) is a process of monitoring the state of an object (entrepreneurial ecosystem) using the traditional method of threshold values of economic security criteria (right-hand side) and by creating a predictive model of the object (left side). The main advantage of the predictive model of economic security is the possibility of identifying a potential threat and the subsequent timely application of economic measures.

Figure 4 Mechanism for ensuring economic security



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Expected results:

1 the creation of a unique model (models) of the entrepreneurial ecosystem, the modelling of economic threats and the consequences of their impact, the identification of new trends and correlations

2 the development of proposals for improving state support programs, adjusting the directions of state support, increasing the efficiency of using budgetary funds.

6 Conclusions

The ecosystem of small and medium-sized businesses is a unique economic institution that has a complex and constantly evolving structure. Small and medium business is an important link in ensuring the economic security of the Russian Federation. The existing problems of monitoring the activities and development of small and medium-sized businesses can be solved using predictive models. The main advantage offered by the authors of the predictive model is the ability to predict and prevent threats to economic security

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